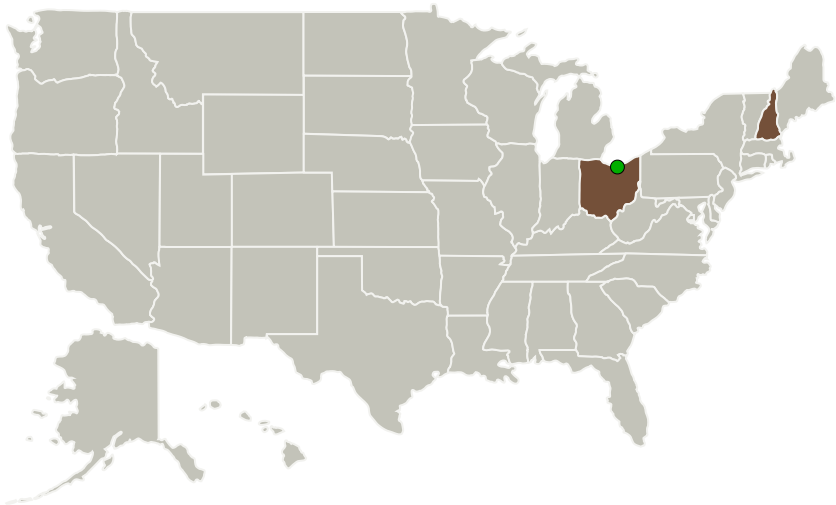
A New Cryocooler for MgB2 Superconducting Systems in Turboelectric Aircraft, Phase II

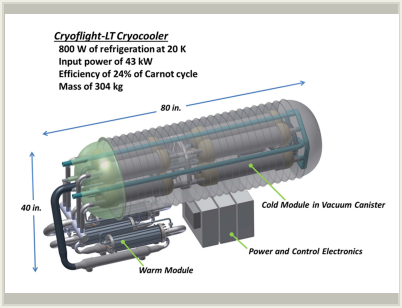
Completed Technology Project (2016 - 2018)

Project Introduction

Turboelectric aircraft with gas turbines driving electric generators connected to electric propulsion motors have the potential to transform the aircraft design space by decoupling power generation from propulsion. Resulting aircraft designs such as blended-wing bodies with distributed propulsion can provide the large reductions in emissions, fuel burn, and noise required to make air transportation growth projections sustainable. The power density requirements for these electric machines can only be achieved with superconductors, which in turn require lightweight, high-capacity cryocoolers. Creare has previously developed a Cryoflight turbo-Brayton cryocooler concept that exceeds the mass and performance targets identified by NASA for superconducting aircraft with high-temperature superconducting (HTS) materials requiring cooling to 50 K. Here, we extended the temperature range of our cryocooler with an innovative new cycle concept to provide cooling to 20 K for MgB2 superconductors, which offer price and performance advantages for certain superconducting machines. In Phase I of this project, we evaluated the performance advantages of our concept through modeling and preliminary component designs. In Phase II, we will fabricate and test the highest-risk components to bring the overall TRL to 4. In Phase III, we will build and test a complete cryocooler to support extended performance testing with MgB2 systems. This development effort will provide an enabling technology for the superconducting systems needed to make turboelectric aircraft feasible.

Primary U.S. Work Locations and Key Partners





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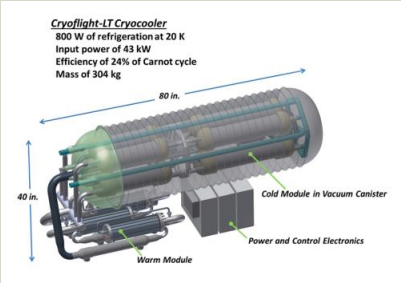
Completed Technology Project (2016 - 2018)

Organizations Performing Work	Role	Type	Location
Creare LLC	Lead Organization	Industry	Hanover, New Hampshire
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
New Hampshire	Ohio

Images



Briefing Chart Image
A New Cryocooler for MgB2 Superconducting Systems in Turboelectric Aircraft, Phase II *(https://techport.nasa.gov/image/133977)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Creare LLC

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Mark Zagarola

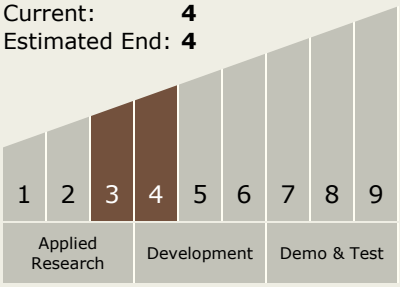
Co-Investigator:
Mark Zagarola

A New Cryocooler for MgB2 Superconducting Systems in Turboelectric Aircraft, Phase II

Completed Technology Project (2016 - 2018)

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.1 Cryogenic Systems
    - TX14.1.3 Thermal Conditioning for Sensors, Instruments, and High Efficiency Electric Motors

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System